Blatchley, W. S. 1910. An Illustrated Descriptive Catalog of the Coleoptera or Beetles Known to Occur in Indiana. Nature Publishing, Indianapolis. 1386 pp.

Downie, N. M. 1970. Notes on a rare beetle, *Cerophytum pulsator* Hald. Coleopterists Bulletin 24: 128.

Dury, C. 1902. A revised list of the Coleoptera observed near Cincinnati, Ohio, with notes on localities, bibliographical references and description of new species. Journal of the Cincinnati Society of Natural History 20: 107-196.

Erwin, T. L. 1981. Natural history of Plummers Island, Maryland XXVI. The ground beetles of a temperate forest site (Coleoptera: Carabidae): An analysis of fauna in relation to size, habitat selection, seasonality, and extinction. Bulletin of the Biological Society of Washington 5: 105-224.

Horn, G. H. 1886. A monograph of the species of the sub-families Eucneminae, Cerophytinae and Perothopinae inhabiting the United States. Transactions of the American Entomological Society 13: 5-58.

Lawrence, J. F. 1991. Cerophytidae (Elateroidea). Pp. 409-410 *In* F. W. Stehr (ed.), Immature Insects, Volume 2. Kendall/Hunt Publishing Company, Dubuque, Iowa.

Peck, S. B. & M. C. Thomas. 1998. A Distributional Checklist of the Beetles (Coleoptera) of Florida. Arthropods of Florida and Neighboring Land Areas 16: 1-180.

Ulke, H. 1902. A list of the beetles of the District of Columbia. Proceedings of the U.S. National Museum 25(1275): 1-57.

White, R. E. 1983. A Field Guide to the Beetles of North America. Houghton Mifflin Company, Boston. 368 pp.

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Mass Mortality of Red-spotted Newts (*Notophthalmus viridescens viridescens* Rafinesque) on a Central Virginia Road

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Large numbers of amphibians and reptiles are killed annually on highways and roads in North America by vehicular traffic (Carpenter & Delzell, 1951; Dodd et al., 1989; Rosen & Lowe, 1994; Fahrig et al., 1995; Ashley & Robinson, 1996). Roads located near or adjacent to wetlands pose special problems for amphibians, especially those that move to and from terrestrial retreats to breeding sites on a seasonal basis (Palis, 1994). Road mortality in pond-breeding ambystomatid salamanders during their breeding migrations has been observed in several locations (Klemens, 1993; JCM, personal observations). In the mountains of Virginia, red-spotted newts (*Notophthalmus viridescens viridescens*) arrive in breeding ponds in March in large breeding migrations and leave en masse in August for terrestrial hibernacula (Gill, 1978). Gill found that juveniles leave the ponds in late summer and early fall months but did not observe mass migrations. Mass migrations of juveniles have been documented in Massachusetts (Dunn, 1930; Stein, 1938; Healy, 1975), New York (Hulbert, 1969, 1970), North Carolina (Chadwick, 1944), and Ohio (Smith & Pfingsten, 1989), with the highest numbers occurring on

nights with rainfall. Such migrations of adults and juveniles in areas with roads increase the risk of mortality from vehicular traffic.

On 4 October 1991, I observed mass mortality of *Notophthalmus viridescens* on County Route 629 where it passes along a beaver-maintained wetland adjacent to Beaverdam Creek, 4.2 km NE Maidens, Goochland County, Virginia. I counted 182 dead and 4 live immature newts (efts) in a 0.25 km stretch of the hard surface road. Conditions of the specimens formed two categories, dry (older road kills) and moist (recent road kills), reflecting at least two periods of movement activity. These groups may have corresponded to two larval size classes like those observed in New York by Hulbert (1970). The moist group may have been killed during the rainfall of 2 October. The newts were counted but not measured due to time constraints. However, all sizes of efts were represented, ranging from very small ones to those that were showing green coloration, suggesting that they were near reproductive maturity. The stretch of road on which dead salamanders were found consisted of two sections, the part adjacent to the wetland without canopy and the part immediately to the east with partial canopy from the adjacent mixed hardwood and pine forest. Numbers of salamanders were approximately equal in both sections.

I visited the site again on several dates in 1992 and once in 1994 but did not find large numbers of dead efts. None was found on 17 April 1992, although one northern cricket frog (*Acris crepitans*) and one spring peeper (*Pseudacris crucifer*) were found dead in the wooded section of the road. I found six dead efts (mean SVL = 33.7 $\pm$ 3.1 mm, 30-37) on 1 September 1992, 10 dead efts (mean SVL = 37.4 $\pm$ 3.5 mm, 33-43, n = 8) on 17 September 1992, and eight (each 35 mm SVL, n = 2) on 29 November 1992. Most of the salamanders were found in the wooded section of the road. On 14 November 1994 I found 10 dead efts and one live eft on the section of the road adjacent to the beaver pond. I had originally hypothesized that mass migration in the fall should lead to mass mortality on this road. The large number found in October 1991 may have been a chance event or related to an unusually large production of cohorts that year. Road mortality impacts on this local population apparently occur at low intensities each year but high rates of mortality apparently do not appear to be a frequent event.

Road mortality was suspected by Hoffman (1992) to be the primary source of decline in frog populations in the Clifton Forge area of Alleghany County between the 1950s and early 1990s. Reptile populations in Virginia, especially snakes, suffer losses annually due to road mortality (Mitchell, 1994 and unpublished). Roads fragment habitats and further contribute to declines in animal populations (Mader, 1984; Andrews, 1990). Because road construction and widening projects continue unabated, it is likely that vehicular traffic will continue to be a significant cause of red-spotted newt mortality and possible population decline in Virginia.

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LITERATURE CITED

Andrews, A. 1990. Fragmentation of habitat by roads and utility corridors: a review. Australian Zoologist 26: 130-141.

Ashley, E. P., & J. T. Robinson. 1996. Road mortality of amphibians, reptiles, and other wildlife on the Long Point Causeway, Lake Erie, Ontario. Canadian Field-Naturalist 110: 403-412.

Carpenter, C. C., & D. E. Delzell. 1951. Road records as indicators of differential spring migrations of amphibians. Herpetologica 7: 63-64.

Chadwick, C. S. 1944. Observations on the life cycle of the common newt in western North Carolina. American Midland Naturalist 32: 491-494.

Dodd, C. K., Jr., K. M. Enge, & J. N. Stuart. 1989. Reptiles on highways in north-central Alabama. Journal of Herpetology 23: 197-200.

Dunn, E. R. 1930. Reptiles and amphibians of Northampton and vicinity. Bulletin of the Boston Society of Natural History 57: 3-8.

Fahrig, L., J. H. Pedlar, S. E. Pope, P. D. Taylor, & J. F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73: 177-182.

Gill, D. E. 1978. The metapopulation ecology of the red-spotted newt, *Notophthalmus viridescens* (Rafinesque). Ecological Monographs 48: 145-166.

Healy, W. R. 1975. Breeding and postlarval migrations of the red-spotted newt, *Notophthalmus viridescens*, in

Massachusetts. Ecology 56: 673-680.

Hoffman, R. L. 1992. Anuran population declines in western Virginia. Catesbeiana 12: 34-35.

Hulbert, S. H. 1969. The breeding migrations and interhabitat wandering of the vermillion-spotted newt, *Notophthalmus viridescens* (Rafinesque). Ecological Monographs 39: 465-488.

Hulbert, S. H. 1970. The post-larval migration of the red-spotted newt *Notophthalmus viridescens* (Rafinesque). Copeia 1970: 515-528.

Klemens, M. W. 1993. Amphibians and Reptiles of Connecticut and Adjacent Regions. State Geological and Natural History Survey of Connecticut, Bulletin Number 112, Hartford, CT. 318 pp.

Mader, H.-J. 1984. Animal habitat isolation by roads and agricultural fields. Biological Conservation 29: 81-96.

Mitchell, J. C. 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington, DC. 352 pp.

Palis, J. G. 1994. Natural history: *Rana utricularia*, road mortality. Herpetological Review 25: 119.

Rosen, P. C., & C. H. Lowe. 1994. Highway mortality of snakes in the Sonoran Desert of southern Arizona. Biological Conservation 68: 143-148.

Smith, C. A., & R. A. Pfingsten. 1989. *Notophthalmus viridescens* (Rafinesque). Pp. 79-87 *In* R. A. Pfingsten & F. L. Downs (eds.), Salamanders of Ohio, Bulletin of the Ohio Biological Survey 7(2), Ohio State University, Columbus, OH.

Stein, K. F. 1938. Migration in *Triturus viridescens*. Copeia 1938: 86-88.

Aggregations of Red-spotted Newts *(Notophthalmus viridescens viridescens* Rafinesque) in the Shenandoah Valley of Virginia

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Aggregations of red-spotted newt adults on land following pond drying have been mentioned by several authors. Healy (1970) observed aggregations of adults in mud along the margin of two ponds in Massachusetts. Gill (1978) found large numbers of adult newts in decaying logs and in vegetation clumps at the edges of several ponds that had dried completely on Shenandoah Mountain, Virginia, in 1977 but did not provide details on numbers of individuals or sex ratios. Mitchell & Buhlmann (1999) noted that red-spotted newts had been observed under logs and rocks around a sinkhole pond that had dried. This note provides the details of those observations.

I found two aggregations of adult red-spotted newts around the edges of a vernal pond at the Shenandoah Valley sinkhole pond complex in the George Washington National Forest, 3.5 km WSW Sherando, Augusta County, Virginia, in two consecutive years. On 16 October 1997, I found adults in a 25 m diameter pool of shallow water in Pond 11 (see Buhlmann et al., 1999, for descriptions of these ponds and pond number designations). The adjacent pond (Pond 12, connected to